

## CHAPTER 3

### ENGINEER DIVING MISSIONS

Engineer divers help keep the waterborne LOC open. They also support the forward movement of troops and equipment. This support ranges from a 5-man scuba team to deploying a 19-man, deep-sea team using surface-air-supplied breathing equipment. The scuba teams perform inspections, surveys, searches, recoveries, and light work. The deep-sea teams perform extensive diving operations during heavy salvage, construction, or harbor clearance missions.

Seven major essential missions are identified for engineer divers. The missions include--

- Port.
  - Planning and inspection.
  - Construction.
  - Repair.
- Clearance.
  - Salvage.
- Ship husbandry.
  - In-water hull inspections.
  - In-water maintenance.
  - Damage control and repair.
- Physical security.
  - Physical security systems.
  - Security swims.
- LOTS.
  - Hydrographic surveys.
  - Salvage and mooring systems.
  - Petroleum pipeline.
- Offshore petroleum distribution systems (OPDS).
  - Permanently installed submarine pipeline.
  - Single anchor leg mooring system (SALMS).
    - System repair and maintenance.
- River crossing.
  - Survey-crossing site.
  - Obstacle location and removal.
  - Equipment recovery.
  - Bridge inspection and repair.
  - Retrograde operations.
  - Personnel recovery.

## PORT

### PLANNING AND INSPECTION

Preliminary and detailed construction planning is an overall guide for construction activities and is accomplished prior to beginning construction work. Planning should include formulating a strategy for clearing sunken vessels and obstructions from within the port area. The ENCOM headquarters should include a qualified planner from the C&S diving detachment to identify diving requirements and to ensure proper allocation of diving assets. The C&S

detachment assists in the development of a construction plan and provides a scuba inspection team for initial on-site surveys. After completing initial inspections, the C&S detachment will designate the appropriate diving team most capable of performing the mission. The C&S detachment augments the LW team with personnel and equipment for missions requiring extensive diving assets such as major salvage, construction, and harbor clearance. Planning and initial inspections include--

- Conducting initial on-site, underwater surveys to determine the possibility of restoring the port facilities (piers, quays, wharves, dry-dock facilities, marine railway systems, and other port structures) to an operational status.

- Inspecting damaged and sunken vessels and other obstructions in the port to determine requirements for salvage or removal.

- Assisting in development of a salvage strategy for clearing the port area and ship channels.

- Assisting in development of time estimates for salvage and clearance.

- Assessing underwater damage of existing pier facilities.

- Estimating time for underwater construction.

An underwater assessment survey will provide the Army water-terminal commander with a report of existing conditions of underwater port facility structures. A port-bottom profile depicting water depths and obstruction locations will be included in the report. Information provided will assist the area engineer and port construction units in determining the scope of construction required for port repair. It will also assist them in developing a port repair plan and time estimate. A detailed report will include--

- Recommendations for restoration.
- Location and condition of sunken vessels or other obstructions.
- Water depths of ship channels within the port.
- Recommendations for vessel or obstacle removal.
- Location of underwater mines and munitions.

To ensure timely procurement of needed materials, divers must make a detailed underwater survey and assist in developing the bill of materials for repair missions.

**NOTE: Engineer divers can clear mined areas from the surface through the use of sympathetic detonation with**

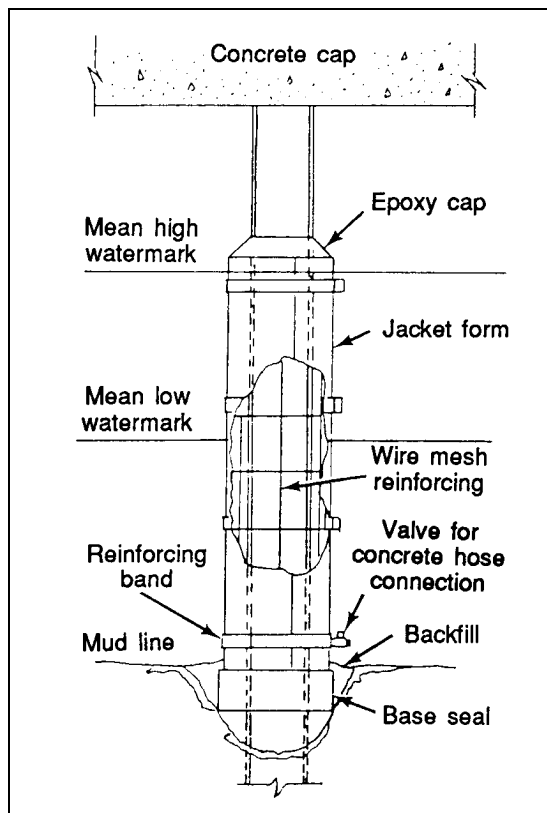
**demolitions. The divers can also mark suspected mined areas or identify mines for removal by qualified Navy explosive ordnance disposal (EOD) teams. The Army does not have EOD-trained diving teams.**

## CONSTRUCTION

The construction of new ports and facilities is a major undertaking which usually requires extensive use of divers. Divers can provide valuable information during initial site selection and survey.

Hydrographic surveys of the proposed area are conducted to determine water depths, sea-bottom contours, and location of ship channels and underwater obstacles. Hydrographic surveys are covered in the Logistics Over the Shore Operations section of this chapter.

The technique for assembling and installing underwater components is similar to the method used on the surface. Detailed port construction techniques are outlined in FM 5-480. Underwater construction and repair techniques can be found in NAVFAC P-990.



**Figure 3-1. Concrete protective jacket around a timber pile**

## REPAIR

The repair method depends on the original construction material, type of repair material, and degree of repair desired.

Divers can perform underwater repair of bearing piles, fender and dolphin systems, and support walls. Underwater structures must be thoroughly cleaned before inspecting and repairing. Inspection and repair of these structures require specialized equipment. Repairs can be as simple as filling minor cracks with special epoxy; installing a concrete protective support jacket; or replacing wooden, steel, and concrete supporting structures and hardware. Figure 3-1 illustrates a damaged woodpile repaired with a concrete protective jacket. Repairs can be as extensive as major rehabilitation and replacement of the underwater structure supports.

Concrete is often used to repair port structures. Underwater concrete placement techniques are basically the same as surface applications; however, the requirement for the diver to wear awkward diving equipment and to work in a zero-visibility environment greatly increases the difficulty of the operation.

Steel is normally used to repair wooden structures such as bearing piles, piers, and fender systems. The repair of steel structures is complex and normally requires thorough cleaning and underwater welding. Special equipment designed for underwater work must be used, and strict safety rules must be followed. High-voltage electricity passes through the water to the welder. This increases the risk of electrical shock.

## CLEARANCE

Clearance operations are undertaken to neutralize all obstacles blocking the shipping channels in ports, docking facilities, mooring sites, marine railways, dry-dock facilities, lock and dam structures, and other navigable waterways. Clearance consists of locating, marking, surveying, and removing underwater obstructions. The operations include removal of natural (underwater rock formations) or man-made obstacles, battle debris, or enemy-emplaced objects intended to prevent the use of navigable waterways or port facilities.

Various methods are used for removing obstructions. These methods include using lifting bags and other equipment from underwater salvage tool kits, demolition charges, cranes, or underwater cutting equipment. Additional lifting force is usually obtained from various items such as empty 55-gallon drums or fuel container bags commonly found in a port facility.

Demolitions provide an efficient method for removing underwater obstacles in the port area. Most explosives are designed for underwater use; however, their effectiveness is sometimes degraded due to the change in environment from air to water. For example, shaped charges require a low-density material, such as air, directly underneath the main charge. This low-density material is changed upon entry into the water.

Special precautions are required when employing demolitions underwater. Electric firing systems should be used whenever possible to control the charge detonation, thus increasing diver safety. Safe distances must be extended because of increased distance and density of the shock impact resulting from water pressure. Charges detonated near any vessel or personnel in the water can cause substantial damage or injury.

Underwater cutting operations are usually required to reduce an obstacle to manageable size for removal. Special underwater cutting and welding sets are available. Hydraulic, pneumatic, and special hand-tools increase work efficiency.

**NOTE: Diving teams normally require the supported unit to provide a welding machine for this mission (a 400-ampere power source is required).**

## SALVAGE

Major salvage operations include the clearance and removal of sunken vessels, equipment, supplies, or other materials from port channels, berthing and docking facilities, mooring sites, lakes, lock and dam facilities, and other navigable waterways. The diver's ability to salvage vessels or other equipment depends on the type, size, and location of the object and time available for the salvage effort. Methods of

salvage range from simple hole-patching and dewatering to completely dismantling a vessel into sections for removal. Beached vessels resting on the bottom with the superstructure above the mean low watermark are salvaged by patching exterior holes and dewatering the hull. The vessels can then be towed to another location for repair by qualified personnel.

Sunken vessels with the superstructure below the mean low watermark require more extensive salvage efforts. Divers must make the entire vessel watertight, which usually means penetration dives into the vessel interior for inspection and repair work. The vessel is then lifted by dewatering, attaching underwater lifting

devices to the hull, or lifting with surface-support cranes. Sometimes a combination of these techniques is necessary.

Unsalvageable vessels and other equipment can be marked and left in place, sectioned and removed, or flattened with demolitions. Sectioning means cutting into manageable pieces and then removing to designated locations.

**NOTE: Removing large sections of steel may require a surface crane or winching machine from the supported unit. Flattening includes using demolitions to remove the superstructure and crushing the hull into the port bottom.**

## SHIP HUSBANDRY

Ship husbandry is the in-water inspection, maintenance, and repair of vessels. Troops, equipment, and supplies are transported using Army vessels. Army divers are tasked to provide maintenance assistance for these vessels. The ability of divers to perform ship husbandry depends on the following:

- Size and number of vessels requiring support.
- Number of divers available.
- Additional equipment and spare parts needed.
- Mission priority established by the Army water-terminal commander.

The C&S detachment commander can assist the Army water-terminal commander during coordination of ship-husbandry operations. The diving supervisor has overall control and responsibility for diver safety.

Special safety precautions for husbandry operations include--

- Direct coordination between the on-site diving supervisor and vessel master prior to the diver entering the water.
- Vessel shutdown and tag out of all systems that may endanger the working divers.
- Coordination with the harbor master to control vessel traffic in the vicinity of the diving operation.

### IN-WATER HULL INSPECTIONS

In-water inspections of military vessels are performed to assess the condition of the underwater hull and appendages. The inspections cover all parts of the vessel below the waterline and are part of the scheduled maintenance or damage assessment. The inspection provides the vessel master with information necessary to determine the condition of the vessel.

Vessel appendages include all zinc anodes, heat exchangers, sonar domes, depth finders, and any exterior-mounted system. In-water hull inspections provide the vessel master information on the following vessel components and appendages:

- Hull. Damage assessment and identification of build up from marine organisms growing on the hull, plus condition of anti fouling paint surfaces.
- Propulsion and steering systems. Condition of shafts, screw propellers, and rudders and the serviceability of protective coatings, seals, and bearings.
- Vessel appendages. Determination of general condition and operational ability.

### IN-WATER MAINTENANCE

In-water maintenance of military vessels is performed for scheduled maintenance or deficiency correction. In-water maintenance enables the Army water terminal commander to have immediate use of his

watercraft. He can also keep the marine railway, dry dock, and other vessel maintenance facilities open for vessels requiring maintenance and repairs that divers cannot perform in water.

Divers provide in-water maintenance of the following military vessel systems:

- **Propulsion and steering.** Divers assist in repairing or replacing in-water components of the propulsion and steering systems. The supported unit must supply demolition and crane support, when required to aid in removing and positioning new components.

- **Sea chest and heat exchanger.** These appendages provide cooling to the various power plants on board the vessel. They are easily cleaned in the water using underwater hydraulic equipment and hand-

tools. For more extensive repairs, divers can remove items for repair on the surface.

- **General systems.** Other maintenance includes the clearing of lines, ropes, or other debris from the propeller or the cleaning of any appendage located below the waterline.

## **DAMAGE CONTROL AND REPAIR**

Damage control and repair provide immediate assistance to a vessel in distress. Repairs are temporary in their application and are meant to keep the vessel afloat until permanent repairs are made. Divers can provide assistance ranging from installing small damage control plugs to welding large patches. The vessel commander will direct repair in coordination with the on-site diving supervisor.

## **PHYSICAL SECURITY**

Physical security operations include developing active and passive security systems to protect or provide early warning of impending danger to ports, channels, or pier facilities.

Divers can assist in placing and maintaining permanent physical security systems in port areas, upon fixed bridges, and in waterway lock and dam systems. Divers also perform security swims for waterborne vessels. The request for diving support must include the type of physical security system used.

### **PHYSICAL SECURITY SYSTEMS**

Physical security systems are usually placed at harbor entrances, along the open areas of port facilities, and around bridge abutments. The systems may be passive or active and are designed to stop or detect vessels, underwater swimmers, or floating mines. These systems usually require diving support for installation and maintenance.

Passive security systems require introduction of obstacles or barriers that

restrict the approaches and entrance to a harbor. Barriers across a harbor's access channel usually require constant maintenance and repair. Electronic security systems are designed to detect and, in some cases, deter attack by underwater swimmers. Divers place and secure the systems underwater after qualified personnel assemble the systems on the shore.

### **SECURITY SWIMS**

Divers can perform physical security swims on the underwater portion of a vessel before it enters the port facility or while it is moored outside the secured perimeter. Although divers are capable of performing these inspections, they cannot remove any foreign explosive devices found during the inspection. The removal of these devices is the responsibility of underwater EOD teams. Periodic security swims are necessary on installed physical security systems to detect maintenance requirements and sabotage.

## LOGISTICS OVER THE SHORE OPERATIONS

LOTS are the water-to-land transfer of supplies to support military operations. They are conducted over unimproved shorelines and through partially destroyed, fixed ports; shallow draft ports not accessible to deep-draft shipping; and fixed ports that are inadequate without using

LOTS capabilities. Divers are an important asset during LOTS because of the large number of watercraft involved in the transfer of supplies. The scope of LOTS depends on geographical, tactical, and time considerations.

### HYDROGRAPHIC SURVEYS

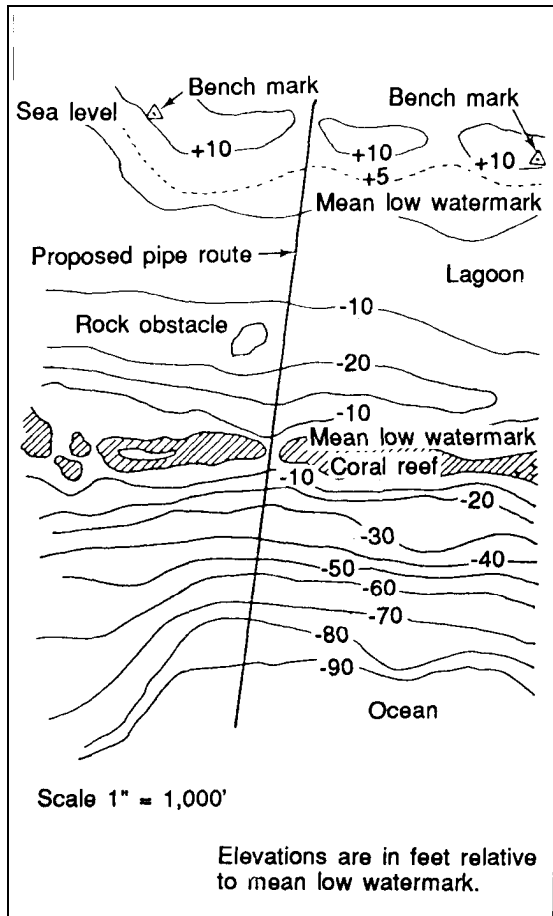
Hydrographic surveys provide the port or LOTS commander with a detailed chart depicting underwater bottom profiles of an operational shoreline or port area. This chart indicates bottom depth gradients, ship channels, and location and type of obstructions which may impede vessel traffic. Figure 3-2 illustrates a typical hydrographic survey for a proposed underwater water pipeline.

### SALVAGE AND MOORING SYSTEMS

Unloading and transporting supplies at sea may result in the loss of supplies into the water. Divers can recover these supplies quickly and assure continued support to fielded units. They can also assist vessel crews by unfouling anchor lines or clearing debris caught in the propellers. In addition, divers can install and maintain offshore mooring systems to provide safe anchorage to cargo vessels, causeways, and landing craft supporting LOTS.

### PETROLEUM PIPELINE

Divers provide underwater support during the installation of OPDS used in LOTS. Divers can perform the surveys necessary to determine pipeline positioning, assist in the actual pipe placement, and provide underwater pipeline inspection and maintenance.



**Figure 3-2. Hydrographic survey**

## OFFSHORE PETROLEUM DISTRIBUTION SYSTEMS

Petroleum distribution systems are used extensively during fuel transfer operations. The transfer of fuel from tankers to the high watermark on shore is a Navy responsibility in joint area operations. However, the engineer port construction companies, engineer diving teams, and transportation watercraft groups play prominent roles in the preparation,

installation, repair, and operation of the OPDS in Army theaters.

### PERMANENTLY INSTALLED SUBMARINE PIPELINE

The construction of a permanently installed submarine pipeline is not expected during mobilization. However, systems already in

place may require extensive repair and maintenance.

### SINGLE ANCHOR LEG MOORING SYSTEM

The SALMS provides a semipermanent installation for bulk transfer of fuel directly from an offshore tanker to port storage. This system will be employed during OPDS operations, and divers may be required to support it by --

- Performing hydrographic surveys to determine beach gradient and underwater contour.
- Improving beach approaches.
- Clearing enemy-emplaced or natural obstacles from beach approaches.
- Supporting the installation of an OPDS.
- Connecting underwater pipeline components.
- Inspecting pipelines and their components.
- Performing maintenance on underwater pipeline components.

- Performing emergency repairs to damaged pipe sections.

### SYSTEM REPAIR AND MAINTENANCE

The underwater components and mooring assemblies for all types of distribution systems require periodic maintenance support. Specific areas of repair and maintenance performed by divers are--

- Tanker hose discharge assemblies. These connecting hoses are of various types and require periodic replacement of gaskets and damaged sections. Control valves located at pipeline connections require periodic lubrication and seal replacement.
- Mooring systems. Mooring systems prevent ship movement during petroleum transfer operations. Maintenance includes periodic inspection and replacement of chain hardware connections and worn chain sections. Surface marking buoys require periodic cleaning and replacement.
- Pipelines. Permanently installed pipelines need periodic inspection and maintenance to ensure watertight integrity. Divers repair or replace pipe flange connections, damaged pipe sections, and concrete encasements. Divers conduct security swims along the length of the pipeline to verify pipeline integrity.

## RIVER CROSSING

Divers are capable of providing support during river-crossing operations. Most missions are accomplished by separate scuba sections from the C&S detachment or LW teams.

### SURVEY CROSSING SITE

Divers survey proposed river-crossing sites by performing bottom and underwater bank approach profiles. They locate, mark and, if necessary, remove underwater obstacles.

**NOTE: Intelligence collection along enemy-controlled shores is not a function of engineer diving units described in this manual. It is performed by Special Operations Forces divers trained and equipped for unsecured area operations (FM 31-25).**

### OBSTACLE LOCATION AND REMOVAL

Divers assist in neutralizing underwater obstacles. They use sympathetic detonation to clear in-water munitions. This is accomplished by emplacing demolitions on or near underwater obstacles. Demolitions are always detonated from the surface. A clear lane is verified by dragging a cable or weighted line in the specified areas.

### EQUIPMENT AND PERSONNEL RECOVERY

Divers assist in the recovery of sunken equipment and tools and provide water casualty search and recovery.

**BRIDGE INSPECTION AND REPAIR**

Divers perform in-water repair of float and fixed bridging. They also provide damage assessment and help determine bridge trafficability.

**RETROGRADE OPERATIONS**

Divers support retrograde operations by placing underwater demolition charges on bridge supports, anchorage systems, and salvageable equipment to prevent enemy use.